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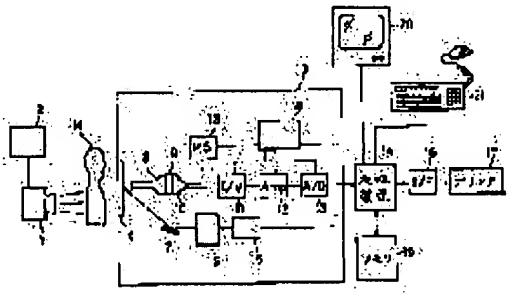
(54) DYNAMIC RANGE COMPRESSION PROCESSING UNIT FOR RADIATION PICTURE

(57)Abstract:

PURPOSE: To confirm and correct a compression processing parameter not dealt with by automatic compression processing by indicating a set compression processing area or a compression degree or various intermediate data when the compression processing parameter is set.



CONSTITUTION: A digital radiation picture signal from a recording reader 3 is processed by a picture processing unit 14 and displayed on a CRT 20. The processing unit 14 has a function as a compression processing parameter setting means and is configured to receive data to correct the characteristic of generating processing via a man-machine interface 21. When the result of automatic dynamic range compression is desired to be corrected and correction data for area designation are entered via the interface 21, the correction area of the CRT 20 is displayed. When data to correct the correction value indicating a compression rate as to the designated area are entered, the correction value with respect to each picture element and various intermediate data are displayed on the CRT 20. Thus, the setting is easily confirmed.

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* NOTICES *

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2.**** shows the word which can not be translated.
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CLAIMS

[Claim(s)]
[Claim 1] It is the dynamic range compression processor of the radiation image which acquires the processed picture signal which processes the original picture signal showing the original image based on the radiation image information which penetrated the photographic subject, and supports the narrow image of a dynamic range rather than said original image. A compression processing parameter setup means to set up at least one side of the field which performs compression processing within an image, and the amendment data for compression processing, A display means to display at least one of the middle data for setting up the middle data for computing the field which performs compression processing within an image, the degree of compression processing, and said amendment data, and the field which performs said compression processing, The dynamic range compression processor of the radiation image characterized by consisting of ******.
[Claim 2] The dynamic range compression processor of the radiation image according to claim 1 characterized by establishing a correction data input means to input the correction data for correcting at least one of the middle data for setting up the middle data for computing the field which performs compression processing within an image, the degree of compression processing, and said amendment data, and the field which performs said compression processing.
[Claim 3] Claim 1 characterized by displaying a processed image with at least one of the middle data for setting up middle data for said display means computing the field which performs compression processing, the degree of compression processing, and said amendment data, and the field which performs said compression processing, or the dynamic range compression processor of a radiation image given in either of 2.
[Claim 4] It is the dynamic range compression processor of the radiation image which acquires the processed picture signal which processes the original picture signal showing the original image based on the radiation image information which penetrated the photographic subject, and supports the narrow image of a dynamic range rather than said original image. The two-sheet display which displays said original image and said processed image side by side, A display gestalt selection means to choose either of the one-sheet displays which display only said processed image, The dynamic range compression processor of the radiation image characterized by being constituted including a display means to display an image according to this display gestalt selection means, and a compression degree modification means to change the compression degree of a dynamic range according to selection of the display gestalt by said display gestalt selection means.
[Claim 5] The dynamic range compression processor of the radiation image according to claim 4 characterized by said compression degree modification means enlarging the compression degree in a two-sheet display compared with the time of an one-sheet display.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the technique on which dynamic range compression processing is made to perform as expected, and a processed image may be displayed more proper in detail about the dynamic range compression processor of a radiation image.
[0002]
[Description of the Prior Art] Conventionally, there are some which are indicated by JP,3-222577,A as an approach of compressing a concentration region, securing observation **** of the fine structure in a field in a radiation image. The compression approach indicated by said JP,3-222577,A is the original picture signal Sorg in the predetermined mask field which contains this each pixel corresponding to each pixel. When the function which carries out monotone reduction is set to f (Sus) as the un-sharp mask signal (dotage mask signal) Sus was searched for by equalizing and this un-sharp mask signal increased, it is Sproc=Sorg+f (Sus) about the processed picture signal Sproc.
It obtains by carrying out.
[0003]
[Problem(s) to be Solved by the Invention] By the way, when signal values differ extremely within an image, there is a case where he wants to make the difference in said signal value held as it is, without compressing a dynamic range. However, according to the conventional dynamic range compression approach, increase amendment with the bigger time when an un-sharp mask signal is smaller is performed. Moreover, since the time when an un-sharp mask signal is larger was the configuration of performing big reduction amendment for example, the base which does not want to amend a signal value when compressing a high concentration field -- there was a problem of lowering the signal value of an omission part beyond the need, or performing an irradiation field diaphragm and raising a part with an extremely low signal value unnecessarily in compression of a low concentration field.
[0004] Furthermore, when the part from which a signal value differs extremely, for example is in the field which does not want to compress, the problem of performing compression processing is in the part. For example, the problem that compression which is not wished that correction value is set up with the function of a signal value is performed, and the part in which this pacemaker exists brings the signal level of a pacemaker close to the signal level of a pulmonary area, and cannot hold the difference in a signal value since a signal value becomes small if metals, such as a pacemaker, are in the pulmonary area section (high concentration section) when compressing the low concentration section by the thorax transverse-plane image arises.
[0005] Although the above problems are predicted to be what can be prevented to some extent by the device of the function form of correction value f (Sus), automatic modification of the amendment property based on discernment of an image field, etc., there is a limitation in preventing the above-mentioned problem stably by automatic amendment in radiography of the medical application which photos various photographic subjects. Moreover, when the image which performed compression processing of a dynamic range to those who have got it used to seeing the radiation image which has not

performed compression processing of a dynamic range was offered, interpretation-of-radiogram nature might be reduced on the contrary.

[0006] While enabling it to make a check and correction of the compression processing parameter which this invention is made in view of the above-mentioned trouble, and is not corresponded and turned off by automatic processing of dynamic range compression, even if it is the case where it is not got used to seeing the image with which dynamic range compression processing was performed, it aims at providing the dynamic range compression processor which can be performed in the display which does not worsen interpretation-of-radiogram nature.

[0007]

[Means for Solving the Problem] Therefore, the dynamic range compression processor of the radiation image concerning this invention It is the dynamic range compression processor of the radiation image which acquires the processed picture signal which processes the original picture signal showing the original image based on the radiation image information which penetrated the photographic subject, and supports the narrow image of a dynamic range rather than said original image. A compression processing parameter setup means to set up at least one side of the field which performs compression processing within an image, and the amendment data for compression processing, the field which performs compression processing within an image -- ** -- it was made to be constituted including a display means to display at least one of the middle data for setting up the middle data for computing the degree and said amendment data of compression processing, and the field which performs said compression processing

[0008] It is desirable to establish a correction data input means to input the correction data for correcting at least one of the middle data for setting up the middle data for computing the field which performs compression processing within an image, the degree of compression processing, and said amendment data here in addition to the above-mentioned configuration, and the field which performs said compression processing. Furthermore, it is good to display a processed image with at least one of the middle data for setting up middle data for said display means computing the field which performs compression processing, the degree of compression processing, and said amendment data, and the field which performs said compression processing.

[0009] Moreover, it made constituted including a display gestalt selection means choose either of the two sheet display which displays an original image and a processed image side by side, and the one sheet display which display only a processed image, a display means display an image according to this display gestalt selection means, and a compression degree modification means change the compression degree of a dynamic range according to selection of the display gestalt by said display gestalt selection means.

[0010] It is good for said compression degree modification means to be made to enlarge the compression degree in a two-sheet display here compared with the time of an one-sheet display.

[0011]

[Function] According to this configuration, it has a compression processing parameter setup means to set up at least one side of the field which performs compression processing within an image, and the amendment data for compression processing. In the equipment which performs compression processing of a dynamic range based on the setting result by this setting means By displaying at least one of the middle data for setting up the middle data for computing the field which performs compression processing within an image, the degree of compression processing, and said amendment data, and the field which performs said compression processing When **** of compression processing could be judged based on said displayed data and the property of compression processing has been recognized, the interpretation of radiogram of the processed image can be carried out.

[0012] It becomes possible to correct unsuitable forward [of automatic setting of compression processing conditions], and to make expected compression perform here by enabling it to input the correction data for correcting the various parameters in connection with said compression processing displayed. furthermore -- the case where can judge easily **** of the parameter set automatically by the ability carrying out the interpretation of radiogram of the processed image, recognizing a processing

property, and correction data will be made to input further with the parameter in connection with compression processing if it is made to display a processed image -- proper ** of correction data -- it can judge now easily.

[0013] It enables it to choose either of the two-sheet displays which, on the other hand, display the one-sheet display of only a processed image, and two original images and processed images side by side as a gestalt which displays a processed image, and an original image and a processed image are contrasted at the time of a two-sheet display, and it enables it to perform the interpretation of radiogram by each. Here, at the time of an one-sheet display, when a big compression degree is set up, there is **** which makes the image information which the original picture signal is supporting lose, but since an original image is also displayed, at the time of a two-sheet display, even if the information on an original image is lost by big compression processing, there is no trouble, and the interpretation-of-radiogram nature of a part hard to see can be improved by the original image at it by setup of a bigger compression degree than the time of an one-sheet display.

[0014]

[Example] The example of this invention is explained below. Drawing 1 which shows one example shows the example of a configuration of the dynamic range compression processor of the radiation image concerning this invention, and shows the example which performs thorax radiography of the body as medical application.

[0015] Here, the radiation generation source 1 is controlled by the radiation control unit 2, and irradiates a radiation (generally X-ray) towards photographic subjects (body thorax etc.) M. The record reader 3 equips the radiation source 1 and the field which counters with the conversion panel 4 on both sides of a photographic subject M, and this conversion panel 4 accumulates the energy according to the rate distribution of a radioparency of the photographic subject M over the exposure dose from the radiation source 1 in an accelerated-phosphorescence layer, and it forms the latent image of a photographic subject M there.

[0016] Said conversion panel 4 has prepared the accelerated-phosphorescence layer on the base material by gaseous-phase deposition of a photostimulable phosphor, or photostimulable phosphor coating spreading, and this accelerated-phosphorescence layer is covered or covered with a protection member in order to intercept the bad influence and damage by the environment. As this photostimulable phosphor ingredient, an ingredient which is indicated by JP,61-72091,A or JP,59-75200,A is used, for example.

[0017] The light beam generating sections (gas laser, solid state laser, semiconductor laser, etc.) 5 generate the light beam by which outgoing radiation reinforcement was controlled, and the light beam reaches a scanner 6 via various optical system, receives a deviation there, further, it deflects an optical path with a reflecting mirror 7, and is led to the conversion panel 4 as an accelerated-phosphorescence excitation scan light. The conversion panel 4 by which accelerated-phosphorescence excitation light is scanned is approached, the condensing edge which is an optical fiber is located, and the condensing body 8 receives accelerated-phosphorescence luminescence of the luminescence reinforcement which is proportional to latent-image energy from the conversion panel 4 scanned by the above-mentioned light beam. 9 is a filter which passes only the light of an accelerated-phosphorescence luminescence wavelength field from the light introduced from the condensing body 8, incidence of the light which passed this filter 9 is carried out to the photograph mull 10, and photo electric conversion is carried out to the current signal corresponding to the incident light.

[0018] The output current from the photograph mull 10 is changed into a voltage signal by the current / electrical-potential-difference converter 11, and after being amplified with an amplifier 12, it is changed into the radiation picture signal which consists of digital data for every pixel with A/D converter 13. And the sequential output of this digital radiation picture signal (original picture signal Sorg) is carried out at the image processing system 14 having a microcomputer.

[0019] 15 is an image memory (magnetic disk drive) for making the picture signal memorize. Moreover, 16 is an interface for transmitting the radiation picture signal read from direct or said image memory 15 from an image processing system 14 to a printer 17 (display means). 18 is a reading gain equalization

circuit, light beam adjustment of the light beam generating section 5 on the strength, the gain adjustment of the photograph mull 10 by the supply voltage regulation of the high voltage power supply 19 for photograph mull, the gain adjustment of a current / electrical-potential-difference transducer 11, and an amplifier 12, and adjustment of the input dynamic range of A/D converter 13 are performed by this reading gain equalization circuit 18, and the reading gain of a radiation picture signal is adjusted synthetically.

[0020] Furthermore, CRT equipment 20 (display means) is formed, and various kinds of processing information besides radiation image information is sent and displayed on this CRT equipment 20 from said image processing system 14. Moreover, 21 is the man machine interface of a keyboard, a touch panel, a mouse, etc., and can input now the correction data for correcting the property of the image processing in said image processing system 14 through said man machine interface 21 (correction data input means).

[0021] In addition, the original radiation picture signal Sorg which makes output to said image processing system 14 You may be the approach of reading the image of for example, the radiation film instead of what is limited to the approach of carrying out photoelectrical change and obtaining accelerated-phosphorescence luminescence which the photostimulable phosphor was scanned [luminescence] with excitation light and made the acquisition approach emitting light by photo electric conversion, a method of a fluorescent substance irradiating and changing into fluorescence the radiation which penetrated the photographic subject, carrying out photo electric conversion of this fluorescence, and reading it, etc.

[0022] Original radiation picture signal Sorg Latter one is desirable, although the form proportional to the reinforcement of the detected radiation is sufficient and the form proportional to the logarithm of the reinforcement of the detected radiation is sufficient. Original picture signal Sorg inputted into said image processing system 14 from the record reader 3 here A dynamic range is compressed, it has the dynamic range compression processing facility which acquires the picture signal [finishing / processing] Sproc which supports the narrow image of a dynamic range rather than the original image, and the image processing for this dynamic range compression processing is performed according to the following formulas.

[0023] Sproc=Sorg +f1(Sus)

At an upper type, Sus is the original picture signal Sorg in the predetermined mask field which contains this each pixel corresponding to each pixel. It is the un-sharp mask signal searched for by equalizing. However, said un-sharp mask signal Sus may be a configuration which it is not limited to the approach of searching for by equalization processing in a mask field, and is set up based on a median value etc.

[0024] Moreover, original picture signal Sorg f1 (Sus) added is correction value calculated as a function of the un-sharp mask signal Sus. In addition, the compression approach of a dynamic range is not limited to the approach using the above-mentioned un-sharp mask signal Sus. here -- an image processing system 14 -- original picture signal Sorg signal analysis -- being based -- the profile of a photographic subject -- extracting -- for example, a thorax transverse-plane image -- setting -- a pulmonary area field and base -- a field is divided into an omission field and the photographic subject field except a pulmonary area, and the correction value f1 (Sus) of a different function form to each field is applied.

[0025] namely, this example -- setting -- said image processing system 14 -- the function as a compression processing parameter setup means -- having -- said pulmonary area field and base -- an omission field and the photographic subject field except a pulmonary area are fields which perform compression processing, and the function form of said correction value f1 (Sus) is equivalent to the amendment data for compression processing. And said image processing system 14 outputs the information on the processing field set up as mentioned above and the function form of correction value f1 (Sus) to said CRT equipment 20, for example, as it is shown in drawing 2 , it is made to display it on it. That is, a display means is constituted by said image processing system 14 and CRT equipment 20 (or printer 17) in this example.

[0026] In drawing 2 , the screen of CRT equipment 20 is made right and left for 2 minutes. In the right-

hand side field of a screen The image processed [an original image and], or the function form of correction value fl (Sus) which it lays on top of these contraction images, the classified field (field which performs compression processing) distinguishes by different color with, and it is displayed, and shows a compression degree in a left-hand side field -- said -- it distinguishes by different color with and is alike, and it corresponds and is displayed as a graph.

[0027] namely, -- the case where it is shown in drawing 2 -- a pulmonary area field and base, while the condition of having been classified into the omission field and the photographic subject field except a pulmonary area is displayed on the right-hand side of a screen, is based on this display and being able to view and check a field division of compression processing Since it is displayed on screen left-hand side of what kind of function form the correction value fl (Sus) was applied to each field, the amendment property over each field can be grasped.

[0028] If the processing property of dynamic range compression is displayed as mentioned above, it can recognize of what kind of property amendment processing was set up. Moreover, it is good to distinguish by different color with or to make it a boundary display show so that the field where you may be the case where the same function form is applied to all image fields, and a forward value is used as correction value fl (Sus) in this case, the field where a negative value is used, and the field whose correction value is zero may identify, although it made it display in the example of a display shown in drawing 2 that the field where the function forms applied differ is discriminable.

[0029] Moreover, although the correction value over each pixel was shown as a function form, it may be made to show the correction value corresponding to each pixel as a two-dimensional multi-tone image, or to display the to be shown as contour line like and according to correction value fl (Sus) amendment data which shows the amendment level to each pixel to drawing 3 in drawing 2 , notionally (refer to drawing 3). (as a compression degree) Furthermore, as shown in drawing 4 , it is good also as a configuration which is made to display stripe-like two images from which a signal value (concentration) changes continuously or in step, and is displayed so that you may make it this show notionally the change before and behind processing (compression degree) and the profile information of this stripe image may be shown drawing 5 .

[0030] That is, you may display a compression degree quantitatively as a function form by making correction value into a numeric value, or may make it make it indicate what compression performed by the gradation image etc. notionally as mentioned above. Although it was made to display above the field partition of the image finally set up, and a correction function (amendment data) in a certain form, it is good also as a configuration on which middle data used in order to compute the signal value or correction value fl (Sus) which was used in setting up said field partition, such as a multiplier and a reference value, are displayed. [0031] As said middle data, it is the original picture signal Sorg. The area of interest extracted based on signal analysis, such as the un-sharp mask signal Sus, The histogram information (a histogram or accumulation histogram) in this area of interest, Maximum Smax and the minimum value Smin in the area of interest for which it asked in the analysis of the characteristic quantity based on the picture signal analysis used in order to set up a field, and said histogram information, the average, a median, Moreover, the reference value Sus1 (the boundary value of an amendment field or switching point of an amendment property) of the un-sharp mask signal Sus, the multiplier beta of a correction function, etc. which were set up according to said analysis result are raised.

[0032] As for the display of said middle data, it is desirable to consider as combination with a correction function and the combination of two or more middle data. Although drawing 6 shows the example displayed combining the histogram of the signal in an area of interest, and the reference value Sus1 calculated in the analysis of this histogram, as shown in drawing 7 , it is more more desirable still to display a signal line on an original image in piles to the un-sharp mask image of the set-up reference value Sus1 etc. In addition, in drawing 7 , the field surrounded with the profile of a photographic subject by the signal-lines (shown by dotted line) down side, such as a reference value Sus1, will show the amendment object domain in low concentration side compression.

[0033] By the way, the discernment and a setup of a processing field, or the decision of an amendment

property in said image processing system 14 are not necessarily made the optimal. Then, after displaying the compression processing property set automatically by the image processing system 14 as mentioned above, when it is judged that this setup is unsuitable, it is desirable that an operator enables it to correct said setup, and through said man machine interface 21, an operator can input correction data and corrects a processing property with an image processing system 14 at this example based on said correction data.

[0034] In addition, while making it input correction data serially in making the parameter set automatically as mentioned above correct, it being desirable to display an image and correction data on CRT equipment 20, and viewing the display of CRT equipment 20, it is good to make it make a final processed image output to a printer 17 in the phase which was made to display this correction result on CRT equipment 20 immediately, and correction ended.

[0035] For example, an image field is automatically divided by the profile extract of a photographic subject, it is the case where compression processing of a different property for every field is made to perform, and the case where he wants to correct how to divide said image field is explained. First, the profile recognized based on the image analysis in an image processing system 14 is displayed on an original image, for example by the dotted line in piles, as shown in drawing 8 , and it is made to make an operator judge whether this field partition may perform dynamic range compression processing.

[0036] Here, although a correction entry of data is unnecessary when compression processing may be performed according to the result of said automatic recognition, the correction data of a block definition are inputted through said man machine interface 21 to correct the result of said automatic recognition. Two or more parts which want to specifically make the coordinate by the keyboard into a profile (field boundary) newly by the numerical input, touch actuation of the touch panel of the transparence established on the screen of CRT equipment 20, or assignment of the screen top location by the mouse are specified, and the field which connects these one by one and is surrounded is made to recognize as a correction field.

[0037] Moreover, it can also consider as the configuration which corrects a compression degree (correction value) about the appointed field. Drawing 9 is drawing showing the condition of having expressed the correction value (before correction) over each pixel as a two-dimensional multi-tone image, and a correction function f1 (Sus) shall be set up as follows, and it shall compress low concentration (side with a low signal value) here.

[0038]

[Equation 1]

$$f1(Sus) = \begin{cases} \beta\,(Sus1 - Sus) & (Sus \leqq Sus1) \\ 0 & (Sus > Sus1) \end{cases}$$

[0039] By the upper formula, supposing the extremely low field of signal values, such as a pacemaker, is located to a pulmonary area field though said reference value Sus1 is set up so that amendment based on said correction function may not be performed in a pulmonary area field, a setup to which amendment is carried out in the part of said pacemaker will be performed, and contraction amendment of the signal difference to save between the parts of the part of a pulmonary area and a pacemaker will be carried out.

[0040] If there is a setup of the above correction value which is not desired, since that can be checked by display as shown in drawing 9 , correction of the correction value set automatically corresponding to said pacemaker part is made to make here as it is the following. First, as shown in drawing 9 , the field which wants to correct correction value is directed like the time of the above-mentioned field correction by the tab control specification by the mouse or the touch panel, the coordinate input by the keyboard, etc. Since it is complicated, it is [for a field to be made to be directed as a rectangle region (rectangle region shown by the drawing 9 middle point line) which makes a vertical angle two points specified, for example] good to specify a location finely here.

[0041] Subsequently, the correction which makes correction value in said specified field constant value

(for example, 0) by keyboard grabbing etc. is made, and the correction value set up by automatic setting in the form which is not desirable is made to correct according to a field. In addition, although it enabled it to direct a rectangular field by two-point assignment, you may enable it to specify a circular field as the core of a circle, for example with the two-point directions with one on a periphery in said block definition.

[0042] Next, the example of a configuration which corrects middle data is explained. First, Maximum Smax and the minimum value Smin of the signal [in an image processing system 14, carry out automatic recognition of the area of interest of a rectangle including a pulmonary area field, and / analysis / of the signal value in this area of interest / histogram] in said area of interest It asks. And said maximum Smax and the minimum value Smin It is based and the reference value Sus1 of a correction function is set up according to the following formulas.

[0043] Sus1=k-Smax+ (1-k) and Smin In addition, Above k is a constant, for example, is 0.6. It considers as extent. And correction value f1 (Sus) shall be set up according to a function form as shown in said-one number according to said reference value Sus1. Signal lines (****** in drawing 10), such as an area of interest by which automatic recognition was carried out in piles to the original image in the result of this automatic setting as shown in drawing 10, and said reference value Sus1, are displayed, and while displaying said histogram, coincidence is made to display Maximum Smax, the minimum value Smin, and a reference value Sus1 into this histogram as middle data.

[0044] here -- the automatic recognition of said area of interest -- unsuitable -- the inside of an area of interest -- actual -- base -- the omission section -- entering -- base -- the omission section -- maximum Smax in an area of interest ****** -- it incorrect-recognizes and it is assumed that it is that to which the reference value Sus1 was set more greatly than a proper value by this. incorrect recognition of this area of interest -- base -- a histogram top as shows having included the omission section in the area of interest to drawing 10 -- base -- the signal level predicted to be the signal range of an omission -- maximum Smax It can judge by being set up.

[0045] Then, maximum Smax' broken into a true area of interest from said histogram The correction data regarded are inputted and a reference value Sus1 is made to calculate anew. Said true maximum Smax' Although the configuration of the input which specifies one point of the signal shaft on a histogram is the simplest, it may be an input of numeric data. moreover, maximum Smax' the configuration to which the direct reference value Sus1 is made to correct instead of correcting -- you may be -- further -- an area of interest -- base -- the correction data for correcting to the expected field which does not include an omission field are made to input, and you may make it make it redo from the analysis of a histogram

[0046] In any case, it is desirable to display the inputted correction data and a correction field immediately, and a signal line (dotted line of the pulmonary area field part of drawing 10), such as corresponding to corrected reference-value Sus1', is newly displayed, and it can check whether as a result of correcting, the right amendment field has been obtained, and is more desirable. As mentioned above, the compression processing information in an image processing system 14 is once displayed. If it enables it to correct various kinds of parameters set automatically when an operator judges that compression processing is unsuitably set up based on this display It can respond and depend on the amendment demand which cannot respond, suitable dynamic range compression processing can be made to be able to perform, and an operator can make only the processed image judged to be proper print by the printer 17 finally in automatic setting.

[0047] By the way, since it can know [in case a processed image is made to print by the printer 17] what kind of amendment was performed when diagnosing based on a print image if various compression processing information is attached although you may be only a processed image, it is more desirable when raising diagnosis nature. In the example which shows a compression processing field repeatedly to a processed image, and is shown in drawing 11 on a print image, drawing 11 shows signal lines, such as the reference value Sus1 which will show the boundary of an amendment field with the correction function of said-one number, by the dotted line, and shows that the abdomen field of this dotted-line bottom turned into a compression object domain in low concentration section compression.

[0048] Moreover, arrange in a processed image, the diagram of a histogram is made to put in order and print in the example shown in drawing 12, and it is desirable that said reference value Sus1 which will show the boundary of an amendment field is shown on a histogram also here. or [furthermore, / that amendment / what / was made by this to each pixel by preparing the display which shows the correction value corresponding to each pixel as a two-dimensional multi-tone image in the corner of the screen where the processed image was printed in the example shown in drawing 13] -- outline **** -- things are made.
[0049] In addition, the various methods of presentation, such as making said two-dimensional multi-tone image not the thing that limits the compression processing information made to print combining a processed image to the above-mentioned thing but display it as a processed image greatly side by side again etc., can be assumed. Furthermore, you may be the configuration on which both the processed image with which compression which is not desirable was performed, and an unsuitable parameter are made to print by automatic setting of the unsuitable processing parameter of an image processing system 14 instead of what asks the existence of a modify feature, and it can be identified easily in this case in which part there was any error.
[0050] Moreover, as correspondence relation is attached, you may be the configuration which outputs a processed image and the information on compression processing according to an individual, for example, when carrying out hard copy of the image, the information output of said compression processing may be the same hard copy as an image, and you may be the configuration which reads the data made to store in memory and is displayed on CRT with an identification number etc.
[0051] Although the above-mentioned example showed the configuration made to print combining the processed image and compression processing information that compression processing of a dynamic range was performed, it is good also as a configuration on which the original image and the processed image with which compression processing is not performed as shown in drawing 14 are displayed side by side. Moreover, when displaying two images before and behind processing side by side as mentioned above, as shown in said drawing 11 - drawing 13, it is good to attach various kinds of processing information to a processed image side, and to make it make it print.
[0052] In addition, after said original image shows the image before processing with which compression processing of a dynamic range is not performed and is read with the write reading equipment 3 of said drawing 1 , for example, the frequency emphasis and gradation processings other than compression processing may be performed. Moreover, it can consider as the configuration which can choose either of the mode to which a processed image and the original image are put in order and indicated by two sheet as shown in said drawing 14 (the hard copy by the printer 17 and the soft copy by CRT equipment 20 are included), and the mode on which only a processed image is displayed.
[0053] Since what the information which the original image originally had will not be lost if extreme compression is performed here in the case of an one-sheet display mode, or is not a lesion looks like a lesion or information has **** from which the right causes a misdiagnosis by the illusion of an eye, a compression degree has desirable how to bend not much greatly. On the other hand, in a two-sheet display, since what is necessary is just to make more visible the part which could not be easily visible with an original image even if the part which looked good by the original image even if stops being able to be visible easily due to compression processing, since it compares with an original image and a processed image is displayed, a setup of a comparatively big compression degree is permitted.
[0054] Therefore, the dynamic range of a photographic subject is larger than predetermined, and when large compression is desired, a two-sheet display may be made to be chosen, for example, although it is good also as a configuration whose operator performs selection with said two-sheet display mode and one-sheet display mode to arbitration through a man machine interface 21 automatically. When an operator chooses a display mode as arbitration through a man machine interface 21, said man machine interface 21 is equivalent to a display gestalt selection means, and when making it set automatically, an image processing system 14 will be equivalent to a display gestalt selection means.
[0055] The example in the case of performing automatic selection of this display mode is explained below. Here, the low concentration section of a thorax transverse-plane image shall be compressed. And

maximum Smax of the signal [in said image processing system 14, set automatically the area of interest which includes a pulmonary area to an original image, perform histogram analysis of the signal in this field, and] in an area of interest Minimum value Smin It asks.
[0056] correction function fl (Sus) ****** -- the reference value Sus1 of the un-sharp mask signal Sus which determines an amendment field using what was shown in said-one number -- Sus1=k-Smax+ (1-k) and Smin ****** -- it shall be determined And decision any of an one-sheet display and a two-sheet display are chosen Dynamic range deltaS of the photographic subject searched for as Smax-Smin =deltaS is compared with a predetermined value. Dynamic range deltaS of a photographic subject in being larger than a predetermined value A two-sheet display is made to choose in order to make large compression perform, that from which dynamic range deltaS is unnecessary for compression extreme when smaller than a predetermined value, and required sufficient diagnosis nature is obtained also by the one-sheet display of only a processing image is presumed, and an one-sheet display is made to choose.
[0057] A setup of the compression degree according to selection of this display mode is said correction function fl (Sus). It is carried out by changing at least one side of the multiplier beta which can be set, and the multiplier k used for the operation of said reference value Sus1 according to the selection result of a display mode. Specifically, it is the multiplier beta 1 for one-sheet display modes, and k1. The multiplier beta 2 for two-sheet display modes, and k2 It determines whether to have set up beforehand, to have responded to the selection result and to use the multiplier of a gap.
[0058] As a value of said multiplier, it is beta1 =0.6, k1 =0.5, beta2 =0.8, and k2 =0.6, for example. It carries out, a multiplier beta is enlarged at the time of a two-sheet display mode, and correction value is set up more greatly, and a multiplier k is enlarged, and an amendment field is extended. Therefore, in this example, an image processing system 14 will be equivalent to a compression degree modification means.
[0059] In said example, the mask size or frequency characteristics of an un-sharp mask is an important parameter which influences the diagnosis nature of an image. In dynamic range compression processing, the whole density range is compressible, maintaining change (a bone, blood vessel, etc.) of the fine structure by extracting only the extremely-low-frequency component corresponding to change (smooth signal differences, such as the pulmonary area section and pars mediastinalis) of the rough structure of a photographic subject as an un-sharp mask signal Sus, and setting up correction value fl (Sus) based on Sus.
[0060] If mask size is small, when the un-sharp mask signal Sus adds the correction value based on the un-sharp mask signal Sus also including the frequency component not only equivalent to the extremely-low-frequency component corresponding to a rough change of a photographic subject but change of the fine structure, change of the fine structure will be negated and contrast, such as a bone and a blood vessel, will fall.
[0061] On the other hand, if mask size is large, the edge piece of an un-sharp image in a part with a rapid signal value change will worsen, and compression which is not desired near the boundary of the field which wants to compress, and a field not to perform will be performed. Moreover, if mask size is enlarged further too much, even if it adds the correction value based on the un-sharp mask signal Sus by that (it will become a completely flat image when extreme) which is lost to the frequency component equivalent to a rough change of a photographic subject, the dynamic range compression effectiveness will no longer be acquired.
[0062] As a result of an artificer's inquiring in the above viewpoints, it found out that the magnitude of mask size had 10 to 60 desirablemm, and was 15mm to 30mm more preferably by the die length on a life-size image, and it was 20mm to 30mm most preferably. If mask size is smaller than 10mm, since the frequency component corresponding to change of the fine structure will increase rapidly, if correction value is set up based on the un-sharp mask signal Sus searched for in such mask size, the diagnostic engine performance will fall remarkably. Moreover, since Sus will not contain the frequency component corresponding to a rib etc. not to lower contrast in a thorax image or an abdomen image especially although it is low frequency comparatively if Sus will not have a frequency component corresponding to a blood vessel with a thick main artery etc. if mask size is set to 15mm or more, and mask size is set to

20mm or more, an image with the high diagnostic engine performance is obtained.
[0063] If mask size is a rectangle, they are the average of the die length of a shorter side, and the die length of a long side, and a square, they are die length of one side, and a circle and they are a diameter and an ellipse, it will point out the average of a major axis and a minor axis here. Moreover, if the frequency characteristics which an un-sharp mask has instead of mask size describe It is 0.5 when the modulation transfer function of an un-sharp mask is 0.01 cycles / mm. It is 0.5 when it is the above and 0.06 cycles / mm. It is desirable that it is the following. It is 0.5 more preferably at the time of 0.02 cycles / mm. It is 0.5 at the above and the time of 0.04 cycles / mm. It is 0.5 still more preferably hereafter at the time of 0.02 cycles / mm. It is 0.5 at the above and the time of 0.03 cycles / mm. It is the following.
[0064] Furthermore, as for the maximum of the absolute value of the correction value fl (Sus) which is the function of the un-sharp mask signal Sus, in this invention, it is desirable that it is 1/8 to 1/2 of the dynamic range of the area of interest of a photographic subject. For example, when the number of the dynamic ranges of the area of interest of a photographic subject is two, as for the maximum of the absolute value of the amount of compressibility corrections, it is desirable that it is a single figure from 1/4 figure.
[0065] moreover, the time of correction value fl (Sus) being expressed with the linear function of the un-sharp mask signal Sus like beta (Sus1-Sus) -- the desirable range of the beta which inclines and comes out, exists and determines a compression degree -- 0.2-1.0 it is -- more -- desirable -- 0.4-0.8 it is . If the amount of amendments is too small, the dynamic range compression effectiveness will not show up, but on the other hand, if the amount of amendments is too large, the size relation of the concentration for every field in an original image will be reversed, and it will keep (the average concentration of the pars mediastinalis becoming high rather than the average concentration of a pulmonary area), and will become the image which does not bear a diagnosis. For example, when inclination beta of the above-mentioned linear function is made larger than 1, such a problem arises.
[0066]
[Effect of the Invention] Since it was made to display the compression processing field and compression degree which were set up, and various middle data in compression processing of a dynamic range according to this invention as explained above While it can recognize and you can make it reflected in the interpretation of radiogram, when unsuitable OFF is in said setup, what kind of setup was made It can be made to correct to arbitration by the correction entry of data, and there is effectiveness of the ability to make the compression processing which **(ed) to the amendment demand which cannot respond in automatic setting perform.
[0067] Moreover, it enables it to choose either of the two-sheet display which displays an original image and a processed image side by side, and the one-sheet display of only a processed image, and since ** was also made to perform big compression by the time of a two-sheet display being chosen, it is effective [**] in a setup of a big compression degree being attained, without worsening interpretation-of-radiogram nature.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the radiation image reading processor with which this invention is applied.
[Drawing 2] Drawing showing the display condition of a field partition and the function form corresponding to each field.
[Drawing 3] Drawing having shown the correction value for every pixel with the contour line.
[Drawing 4] Drawing in case a step concentration change shows a compression degree.
[Drawing 5] Drawing in case a step concentration change shows a compression degree.
[Drawing 6] Drawing showing the display of the histogram as middle data of amendment.
[Drawing 7] Drawing showing the amendment field display by signal lines, such as a reference value of a mask signal.
[Drawing 8] Drawing showing the situation of correction of an amendment field.
[Drawing 9] Drawing showing the situation of assignment of the specific region for correction of correction value.
[Drawing 10] Drawing showing a display condition with an area of interest and a histogram analysis result.
[Drawing 11] Drawing showing the example which prints an amendment field in piles in a processed image.
[Drawing 12] Drawing showing the example which puts in order and prints a processed image and a histogram.
[Drawing 13] Drawing showing the example on which the correction value shown in the corner of a processed image as a two-dimensional multi-tone image is made to print.
[Drawing 14] Drawing showing the display condition in a two-sheet display mode.
[Description of Notations]
1 Radiation Generation Source
3 Record Reader
14 Image Processing System
15 Image Memory
16 Interface
17 Printer
20 CRT Equipment
21 Man Machine Interface

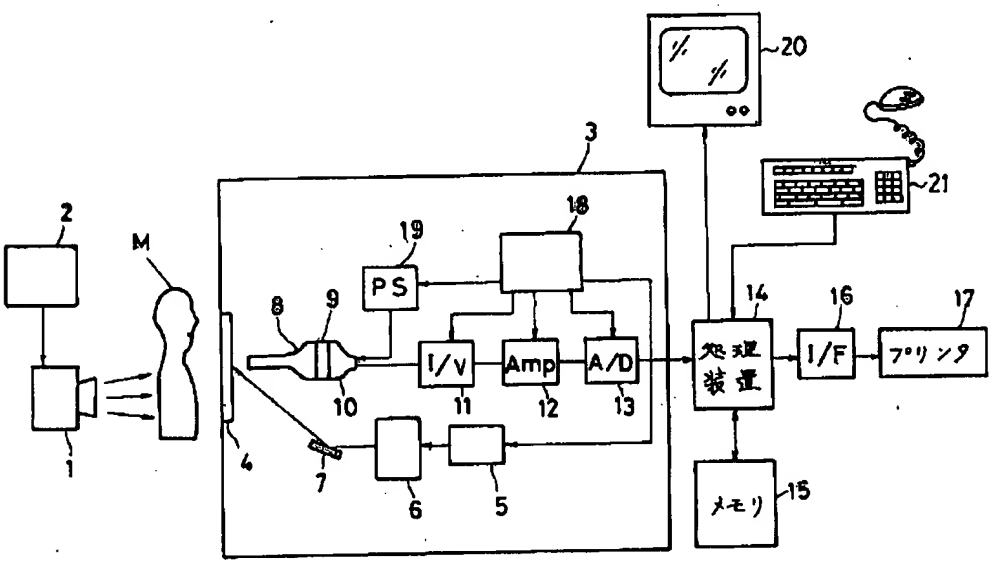
[Translation done.]

* NOTICES *

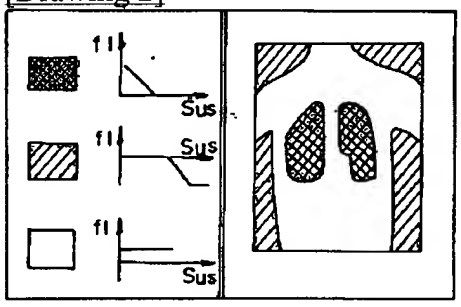
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

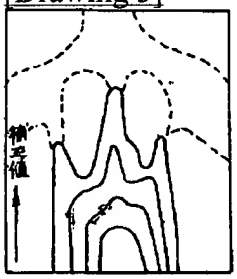
[Drawing 1]



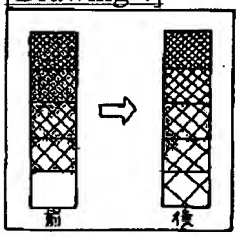
[Drawing 2]



[Drawing 3]



[Drawing 4]



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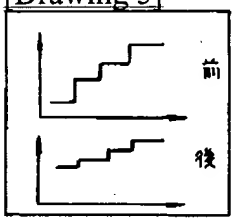
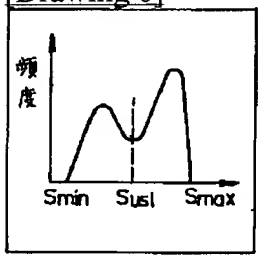
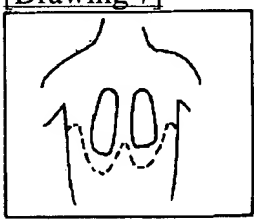


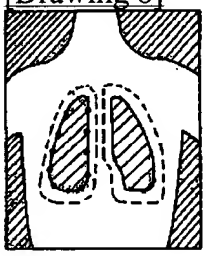
[Drawing 6]



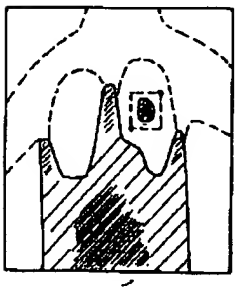
[Drawing 7]



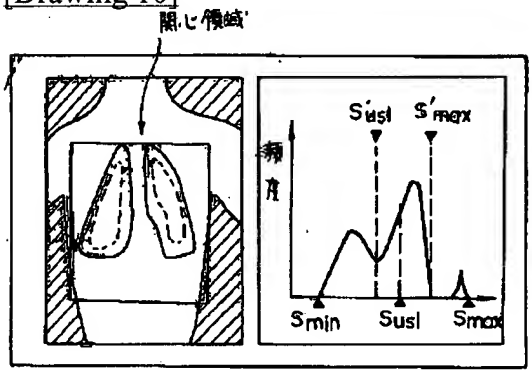
[Drawing 8]



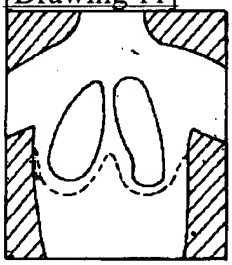
[Drawing 9]



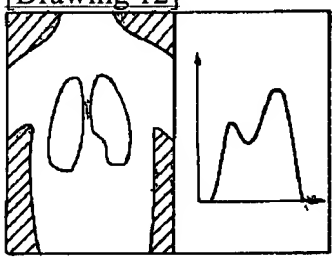
[Drawing 10]



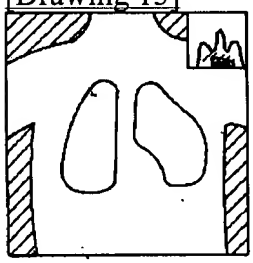
[Drawing 11]



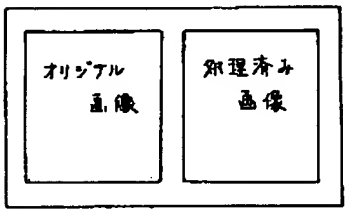
[Drawing 12]



[Drawing 13]



[Drawing 14]



[Translation done.]